California Natural Gas Vehicle Update

Natural Gas Vehicle Technology Forum

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California Energy Commission
www.energy.ca.gov

Presentation Overview

I. California Picture
II. Policy Developments
III. Vehicle Technology Developments
IV. Infrastructure Developments
V. Other Market Developments
VI. Barriers
VII. Future Prospects

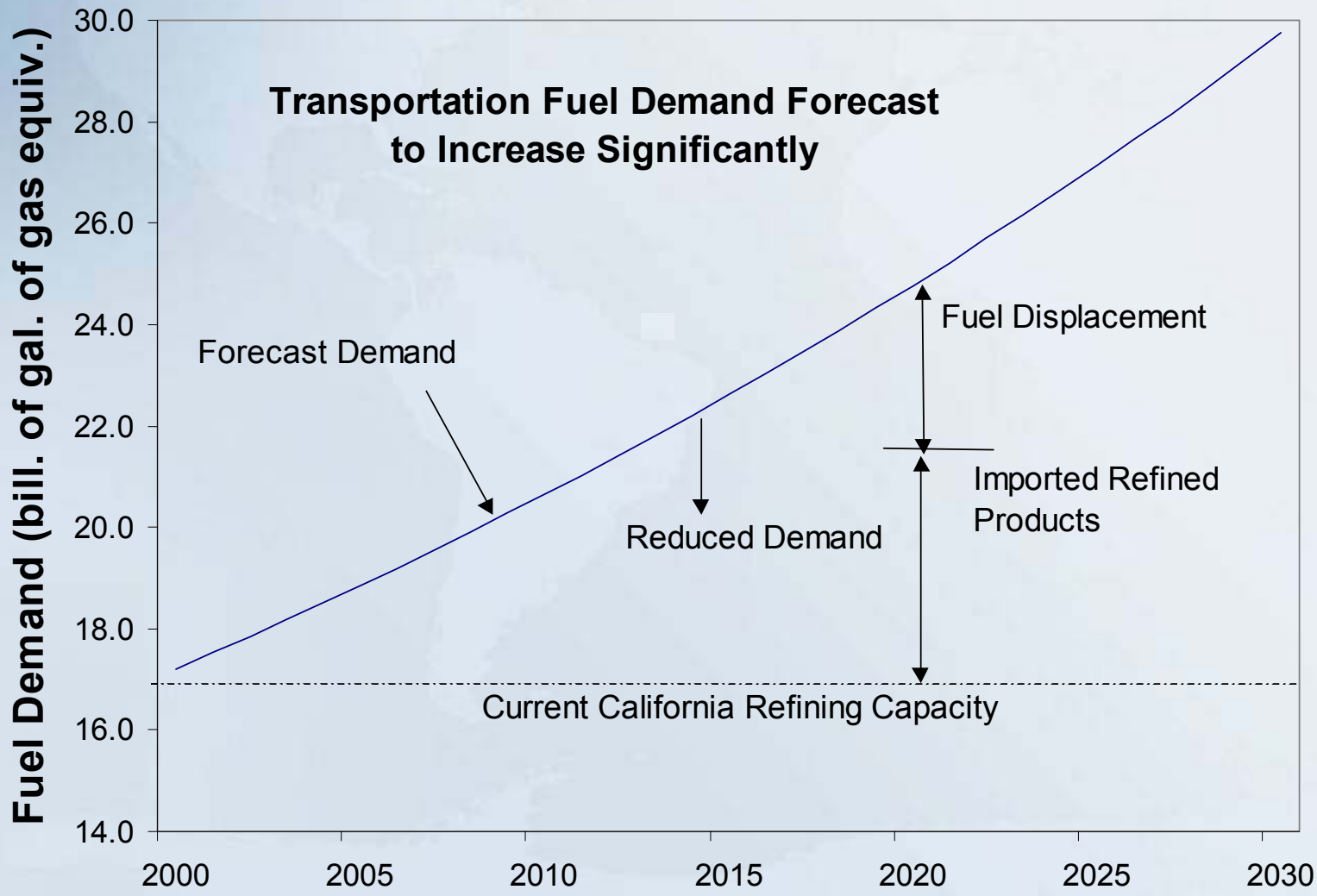
The California Picture

- Natural gas – One of CA's leading alternative fuels
- More commercially available low-emission natural gas vehicles
- Growing number of CNG and LNG vehicles
- 20,000 NGVs in CA today vs. 4000 in 1995
- At 150+ stations, California has largest number of natural gas fueling network in the nation

California Market Drivers

- Air Quality Regulations (Declining leverage)
- Shift in leverage for Alternative Fuels from Air Quality to Petroleum Reduction
- Incentives
- Green Corporate Image
- Value Proposition for Customers

Policy Development: Demand for Gasoline & Diesel



Policy Development: Process to Reduce Demand

- Assembly Bill 2076
- Joint study by the CEC and California Air Resources Board
- Forecast gasoline and diesel consumption in 2010 and 2020
- Recommend statewide goals and strategies to reduce gasoline and diesel consumption

Policy Development: 2076 Report Quotes

- "The Governor and Legislature should adopt the recommended statewide goal of reducing demand for on-road gasoline and diesel to 15 percent below the 2003 level by 2020 and maintain that level…"

- "The Governor and Legislature should establish a goal to increase the use of non-petroleum fuels to 20 percent of on-road fuel consumption by 2020 and 30 percent by 2030."

- "By improving vehicle fuel efficiency and expanding use of non-petroleum fuels, the state can dramatically reduce the demand for petroleum…"

Policy Development: Options to Reduce Petroleum Demand

Fuel Efficiency

- Increased CAFE
- Light-Duty Diesels
- Efficient Government Fleets
- Efficient Tires
- Improved Maintenance

Fuel Substitution

- Natural Gas (CNG & LNG)
- Ethanol blends
- Fischer-Tropsch Diesel
- Hydrogen
- Liquid Propane Gas
- Hybrids / Electrics
- Biodiesel

Policy Development: Options to Reduce Petroleum Demand

Near-Term Options

- Use more fuel efficient replacement tires with proper inflation
- Improve fuel economy in government fleets
- Improve private vehicle maintenance

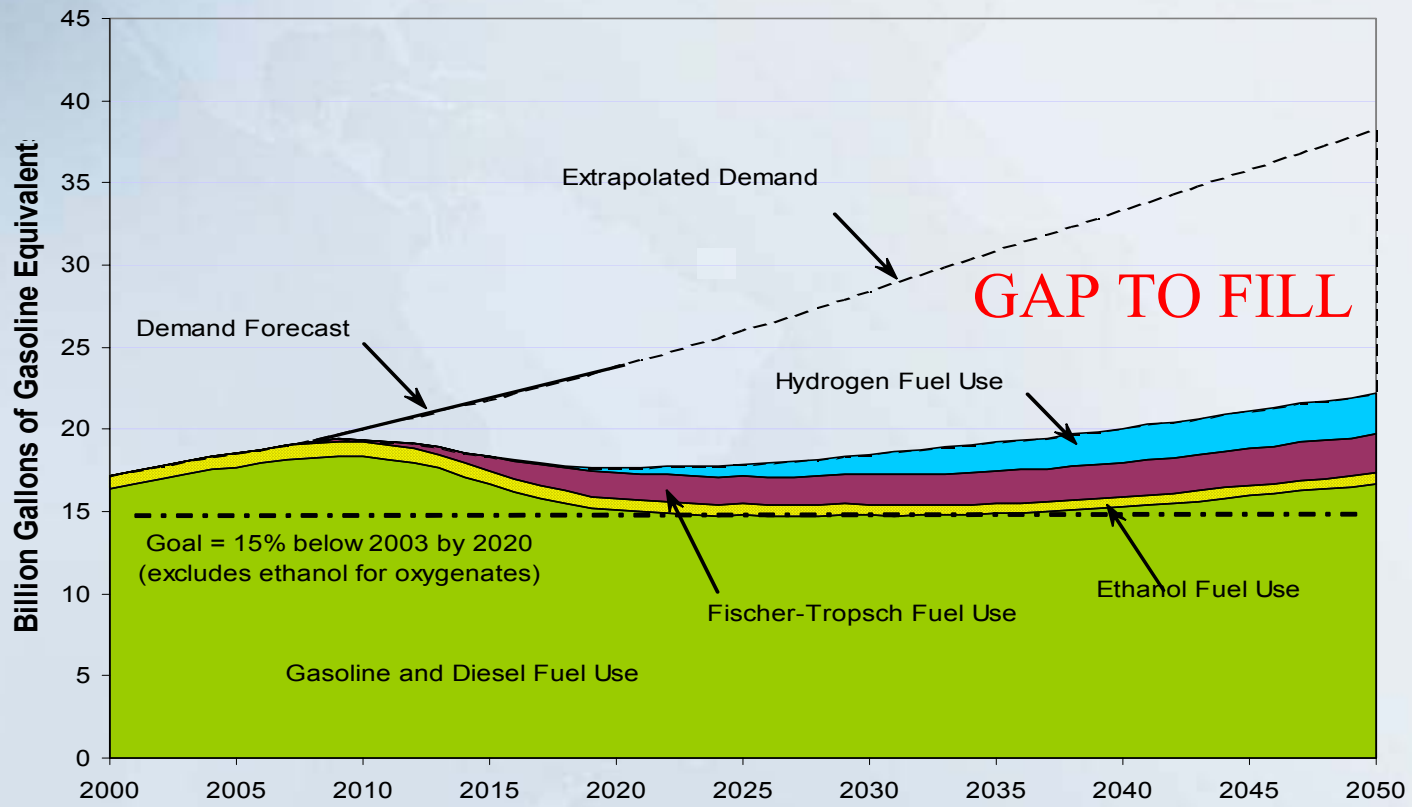
Mid-Term Options

- Double the fuel efficiency of current model light duty vehicles to 40 miles per gallon
- Expanded LNG and CNG use are attractive options that could reduce petroleum with a net societal benefit.

Long-Term Options

- Introduce fuel cell light-duty vehicles in 2012, increasing to 10 percent of new vehicle sales by 2020, and 20 percent by 2030

Policy Development: Impact on Fuel Use



Integrated Energy Policy Report

- Adopted in November 2003
- Overview of major energy trends and issues facing the state
- Develops long-term objectives, strategies and recommends policy initiatives
- An integrated energy summary of:
  - Transportation
  - Electricity
  - Natural gas

IEPR Recommendations

- Reduce gasoline and diesel demand to 15% below 2003 levels by 2020
- Double CAFE fuel economy requirement for cars and light trucks
- Increase the use of non-petroleum fuels to 20% by 2020 and 30% by 2030
- Establish one-stop licensing for petroleum infrastructure

NGV TECHNOLOGIES

- Provide important air quality and petroleum displacement benefits for heavy-duty vehicles such as Transit Buses, Refuse Trucks, and Local Delivery Trucks that stop and start a lot

- Continued support for more competitive NGVs in medium- and heavy-duty applications

- Advances in highlighted engines

NGV TECHNOLOGIES

- Cummins 8.3 C Gas Plus
- Computer for better combustion management
- Wide-range gas composition
- Eliminated Woodward Governor
- Applied to Cummins B5.9 and L8.9

Cummins C8.3G Engine

- DDC Series 50 G Engine
- Equal length in-take manifold
- Humidity Sensor for better control

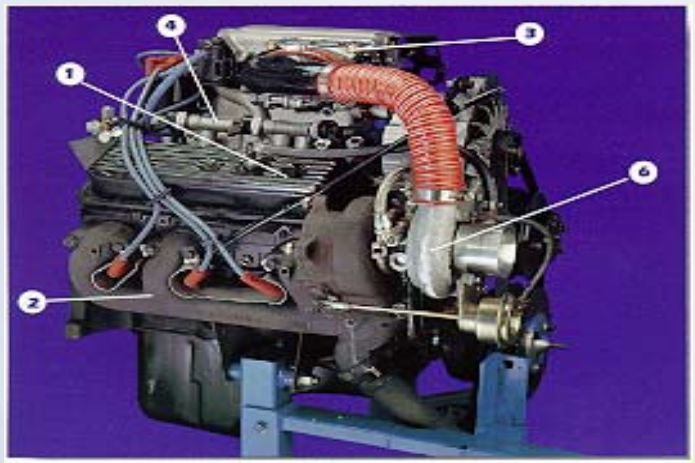
DDC Series 50 G Engine

NGV TECHNOLOGIES

- 250-280 HP Low-emission engine

Deere 8.1L Engine

- 2.5L, 4.3L, 4.8L, 5.0L, 5.3L, 5.7L, 6.0L engines
- EPA & CARB certified low- emission and ultra- low emission CNG systems for GM engines
- Trucks, vans, suvs



Baytech/GM 4.3L Engine

NGV Infrastructure Development

- CA fueling network expanded by 25% and improved in last 5 years
- 50 new CNG, LNG and L/CNG stations
- CEC contributed $6 million or 17.5% of cost share of 41 stations
- Universal Card reader
- More support for small, medium and large-scale natural gas fueling stations

Expanding NG Infrastructure

- CNG and LNG Stations
- High fuel consuming return-to-base fleets
  - Transit Buses
  - Refuse Trucks
  - Pickup & Delivery Trucks

LNG Station, Riverside, CA

LNG Truck Fleet, Harris Ranch, CA

Interstate Clean Transportation Corridor

Interstate Clean Transportation Corridor

- Helped Secure $12.5 million to:
- Build 15 NG fueling stations
- Deploy 240 HD trucks
- Deploy 160 LD vehicles
- Reduce Diesel 2.7 Million Gal./Year
- Reduce 250 Tons/Year NOx

Positive Market Development Activities

- Regular market assessments
- Improving price parity between heavy-duty natural gas and diesel engines
- Tough challenges for diesel after-treatment devices keeps NG engines competitive
- Monetize petroleum reduction benefits
- Expanding Niche Markets

Improving Price Parity

- Data compilation on component and system pricing of diesel engine and emission control technology plus natural gas engine technologies.
- Compares costs for Class 3-8 vehicles for natural gas and diesel engines for 2004 and post 2007 timeframe
- Price gap narrowing between natural gas and diesel technologies

Mixed Results - Diesel After-treatment Devices

- Field data of verified after-treatment devices in several applications and on different engine and vehicle platforms
- Difficult performance and durability requirements for diesel after-treatment devices
- ARB revoked verification for several diesel after-treatment devices
- NGVs will be able to use three-way catalysts with proven efficiency and durability and no loss of fuel efficiency

New Financing Concepts

- Possibility of a transportation technology investment initiative targeting private capital
- Monetizes petroleum reduction, criteria emission and GHG benefits
- Enhances value proposition to investors and end users.

Expanding Niche Markets

- Refuse haulers
- Package and Delivery
- Line Haul Trucks – Return to Base

Barriers

- Traditional (engine performance, limited infrastructure, cost)
- New: Lack of responsive customer support
- Station Siting and Permitting Process

Maintaining the Momemtum

- Secure long-term funding
- Continue technology advancement and infrastructure growth
- Offer engine technologies that achieve 2007 and 2010 NOx standards
- Identify new engine and vehicle technologies that expand niche market segments
- Maintain program direction, emphasis and focus

Conclusion: Future Prospects

- Recent policy, vehicle technology advancement and product offerings, infrastructure expansion and market initiatives suggest:
  - California offers growth opportunities for the NGV market
  - Industry, government and other stakeholders must work together
  - Stakeholders must act on these opportunities to grow the market.